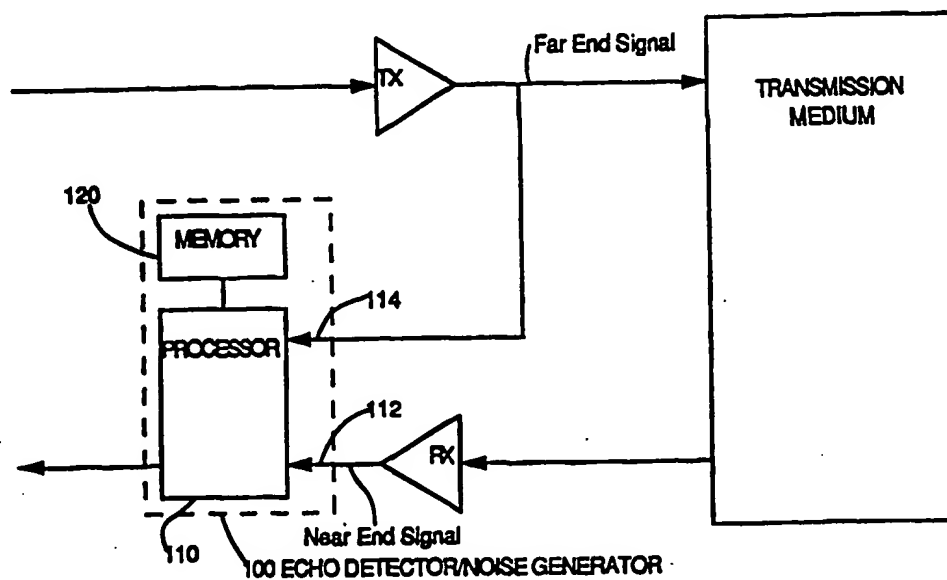




## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(21) International Application Number: PCT/CA97/00485 (22) International Filing Date: 9 July 1997 (09.07.97) (30) Priority Data: 08/839,830           17 April 1997 (17.04.97)           US (71) Applicant: NORTHERN TELECOM LIMITED [CA/CA]; World Trade Center of Montreal, 7th floor, 380 St. Antoine Street West, Montreal, Quebec H2Y 3Y4 (CA). (72) Inventors: SAIKALY, Madeleine; 50, rue Crepeau - #415, Montreal, Quebec H4N 1M8 (CA). RABIPOUR, Rafi; 5745 Blossom, Cote St. Luc, Quebec H4W 2T2 (CA). (74) Agent: JUNKIN, C., W.; Northern Telecom Limited, Patent Dept., P.O. Box 3511, Station "C", Ottawa, Ontario K1Y 4H7 (CA).	(81) Designated States: CA, CN, JP, MX, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published With international search report.	

(54) Title: METHODS AND APPARATUS FOR GENERATING NOISE SIGNALS FROM SPEECH SIGNALS



## (57) Abstract

In methods and apparatus for generating an LPC-encoded noise signal from an LPC-encoded speech signal excitation parameters of the LPC-encoded speech signal for a current frame are randomized upon detection of speech in the current frame. For frames in which no speech is detected, LPC coefficients and frame energy for the current frame may be replaced with respective averages calculated over the current frame and a plurality of preceding frames. For frames in which speech is detected, LPC coefficients for the current frame may be replaced with respective averages of LPC coefficients used to replace LPC coefficients of an immediately previous frame. The comfort noise generation technique is particularly suitable for use in echo suppressors for digital cellular radio systems.

We claim:

1. A method for generating an LPC-encoded noise signal from an LPC-encoded speech signal, comprising:
  - 5 detecting whether speech is present in each frame of the LPC-encoded speech signal; and
  - upon detection of speech in a current frame, randomizing excitation parameters of the LPC-encoded speech signal for the current frame.
- 10 2. A method as defined in claim 1, wherein the step of randomizing excitation parameters comprises randomizing pitch lag values of the current frame.
- 15 3. A method as defined in claim 1, further comprising replacing LPC coefficients of a frame of the LPC-encoded speech signal with respective average values of the LPC coefficients calculated over a plurality of preceding frames.
- 20 4. A method as defined in claim 3, further comprising replacing a frame energy of a frame of the LPC-encoded speech signal with an average value of the frame energy calculated over a plurality of preceding frames.
- 25 5. A method as defined in claim 4, wherein the steps of replacing LPC coefficients and frame energy comprise:
  - for frames in which speech is detected, replacing LPC coefficients and frame energy for the current frame with
  - 30 respective averages of LPC coefficients and frame energy used to replace LPC coefficients and frame energy of an immediately previous frame; and
  - for frames in which no speech is detected and the frame energy exceeds an average frame energy calculated for a
  - 35 plurality of preceding frames, replacing LPC coefficients and frame energy for the current frame with respective

10. A method as defined in claim 5, wherein the LPC coefficients are averaged over between 15 and 25 consecutive 20 millisecond frames.

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11. Apparatus for generating an LPC-encoded noise signal from an LPC-encoded speech signal, comprising a processor and a storage medium for storing instructions for execution by the processor, the instructions comprising:

10 instructions for detecting whether speech is present in each frame of the LPC-encoded speech signal; and

instructions for randomizing excitation parameters of the LPC-encoded speech signal for the current frame upon detection of speech in a current frame.

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12. Apparatus as defined in claim 11, further comprising instructions for replacing LPC coefficients and frame energy of a frame of the LPC-encoded speech signal with respective average values of the LPC coefficients and 20 frame energy calculated over a plurality of preceding frames.

13. Apparatus as defined in claim 12, wherein the instructions for replacing LPC coefficients and frame energy 25 comprise:

instructions for replacing LPC coefficients and frame energy for the current frame with respective averages of LPC coefficients and frame energy used to replace LPC coefficients of an immediately previous frame for frames in 30 which speech is detected; and

instructions for replacing LPC coefficients and frame energy for the current frame with respective averages calculated over the current frame and a plurality of preceding frames for frames in which no speech is detected 35 and the frame energy exceeds an average frame energy calculated for a plurality of preceding frames.

18. A processor-readable storage medium storing instructions for execution by a processor, the instructions comprising:

- 5 instructions for detecting whether speech is present in each frame of an LPC-encoded speech signal; and  
instructions for randomizing excitation parameters of the LPC-encoded speech signal for the current frame upon detection of speech in a current frame.

- 10 19. A medium as defined in claim 18, further comprising instructions for replacing LPC coefficients and frame energy of a frame of the LPC-encoded speech signal with respective average values of the LPC coefficients and frame energy calculated over a plurality of preceding  
15 frames.

20. A medium as defined in claim 19, wherein the instructions for replacing LPC coefficients and frame energy comprise:

- 20 instructions for replacing LPC coefficients and frame energy for the current frame with respective averages of LPC coefficients and frame energy used to replace LPC coefficients of an immediately previous frame for frames in which speech is detected; and  
25 instructions for replacing LPC coefficients and frame energy for the current frame with respective averages calculated over the current frame and a plurality of preceding frames for frames in which no speech is detected and the frame energy exceeds an average frame energy  
30 calculated for a plurality of preceding frames.

21. A medium as defined in claim 20, the instructions further comprising instructions for maintaining the LPC coefficients for the current frame for frames in which no  
35 speech is detected and the frame energy is lower than an average frame energy calculated for a plurality of preceding frames.

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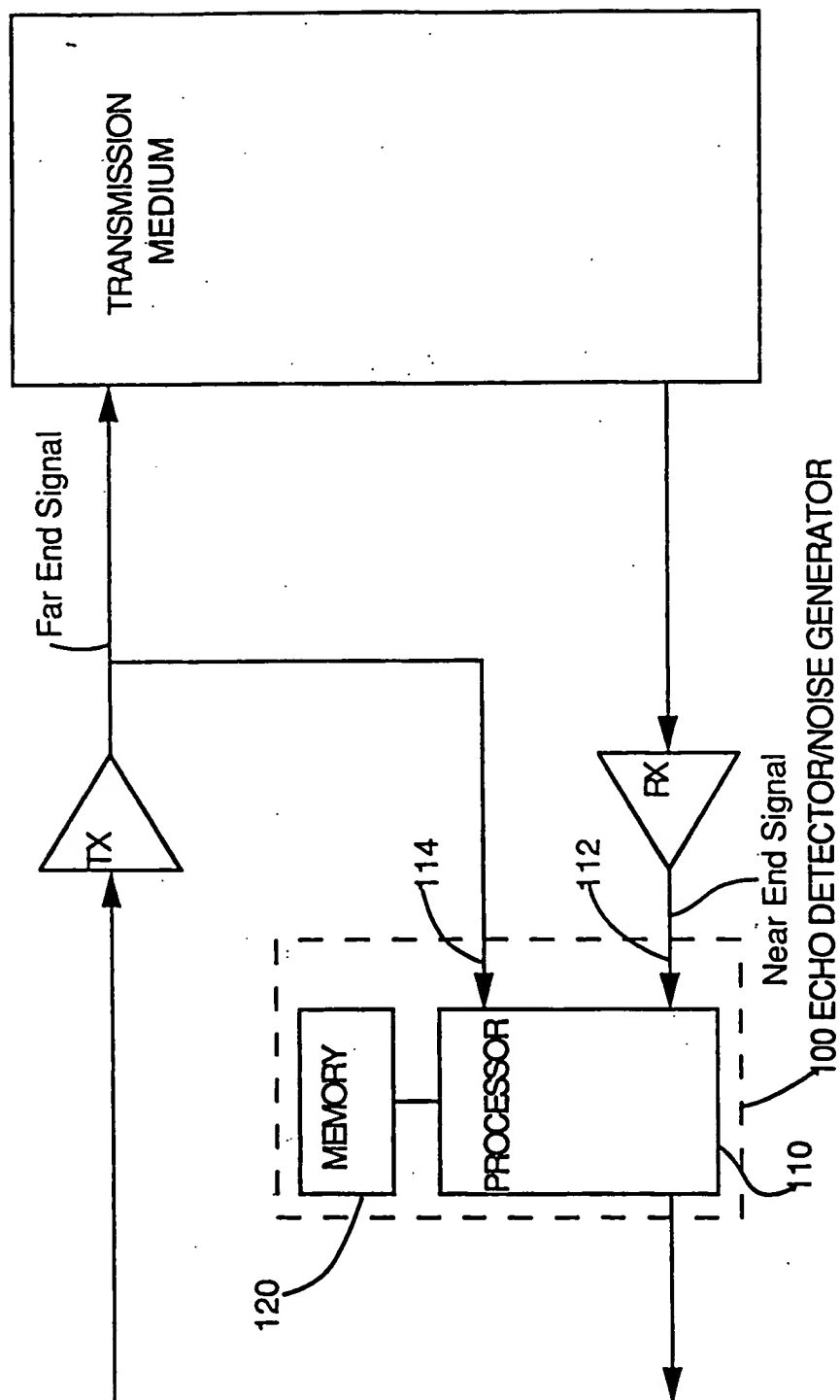


Fig. 1

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/CA 97/00485

A. CLASSIFICATION OF SUBJECT MATTER  
 IPC 6 H04B3/20 G10L5/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 H04B G10L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 3 991 287 A (MAY JR CARL JEROME ET AL) 9 November 1976 see abstract see column 2, line 11 - line 40 see column 3, line 43 - column 4, line 31 see column 5, line 1 - line 19; figure 3 ---	1, 11, 18
Y	EP 0 627 725 A (MOTOROLA INC) 7 December 1994 see abstract see page 3, line 35 - line 47 ---	1, 11, 18
A	WO 96 34382 A (NORTHERN TELECOM LTD) 31 October 1996 cited in the application see page 3, line 1-14 see page 4, line 21 - page 5, line 2 --- -/--	1, 11, 18

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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1 April 1998

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Information on patent family members

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